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Making Circular Streams

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Making circular streams

Above: Clean-up in Bali, Indonesia.

Dr Parvez Alam FIMMM* talks about finding solutions to the Indonesian plastic waste crisis through practicable circular economic models.

As the second highest contributor to oceanic plastic debris globally, Indonesia has become a front-line country in the war against plastic pollution. The problem is now so acute that the Indonesian government has committed to a 70% reduction of its oceanic pollution by 2050, investing approximately US$1bln per annum to deliver on their target. Given the scale of the plastic problem, considerable manpower will be needed to enable targeted changes.

Coastal communities may be a lifeline in the war against oceanic plastic, as by engaging them in the long-term waste management programmes, it may be possible to deliver some of the much-needed manpower. Such communities already play a vital role in protecting the sea as they live in close proximity and may act as either a barrier or a thoroughfare to ocean plastics.

Nevertheless, seeking help from local communities requires a multi-tiered mind-set, since poverty, not pollution, is the predominating concern in rural Indonesia. Therefore, plastic waste management programmes with no clear economic benefits to the coastal communities are unlikely to survive over the longer term. This article focuses on a project led by Edinburgh University, UK, which involved a pilot trial being conducted at a coastal village in Gunungkidul, Indonesia. The objective of our trial was to ascertain the suitability of a plastic waste recycling and reuse programme when setup at the village as a circular micro-economy, run by the community for the benefit of the community.

Indonesia is one of the most biodiverse countries on Earth and is home to myriad endemic species. The world's third-largest rainforest is in Indonesia, as is the much-celebrated coral triangle which itself comprises 76% of all coral species, and the greatest diversity of reef fishes. There is, however, a real threat to Indonesia's marine wildlife. The country's heavily depleted fish stocks are often correlated with overfishing, but much of it is also due to oceanic pollution, of which UN-GESAMP estimates is 60-95% plastic.

The sudden decline of marine wildlife not only damages one of our most valued marine ecosystems, but is also detrimental to the Indonesian fishing industry. 2.8 million fishing households are directly affected by the current shortfalls and it is difficult to estimate how quickly Indonesian fisheries can recover. Although remedial actions have already started taking place, many of them, for instance beach clean-ups, are short-term efforts and unlikely to have long-lasting consequences.

Any long-term stratagy should ensure that a pipeline from 'trash to cash' is comprehensible, low-risk and easily accomplishable. Circular economies are becoming a more common proposition and their implementation requires several interlinking stages. Our Gunungkidul pilot was composed of four main steps:

- Education schemes for villagers
- Shoreline collection strategies
- The design, manufacture and validation of plastic polyethylene terephthalate (PET) bottle shredding and extrusion machines, and
- Sustainability/economic analyses.

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Education programmes

Prudence is beneficial when working in foreign countries. Even when well-intentioned, interference in regular village routines can be treated with suspicion. For this reason, our education programmes were undertaken by native Indonesian speakers through a collaboration with student social service workers from Universitas Gadjah Mada (UGM), Indonesia's oldest top-tier university.

There, every undergraduate student is required to conduct a period of social service of benefit to local communities and community clusters within Indonesia. The university students of UGM focused on transferring knowledge about PET collection strategies, PET conversion strategies, start-up strategies, and practical methodologies for the export and sale of recycled PET obtained from bottle waste.

By developing education programmes specifically targeted to different age groups, the students were also able to ensure that the entire community was involved, rather than only a select few.

Shoreline collection strategies

It has recently been understood that more than 90% of known marine plastic is shoreline debris. The majority of this is usually invisible, often being buried and hence stored under the shoreline. From time to time, PET bottles will be swept onto the Indonesian shores, and as such are easy to find, as are those that have been carried onto river littorals. However, the volumes of shoreline plastics in Indonesia have increased in recent years, and this is due to the significant gentrification of many Indonesian coastal villages.

This move has been made as a means to profit from tourist and eco-tourist activities. As a consequence, plastic waste piles can be found in a range of locations along the coast.

If nothing is done to remediate this, the plastic will almost certainly end up in the ocean or stay buried under the shoreline. Regardless of the recent government drive to curb oceanic plastics, the Indonesian coastline is extensive and there is no realistic or practical way of patrolling it. Thus, for our project, we ensured that easy pathways to PET bottle collection were made available at the targeted village.

Some of the pathways mimicked fundamental beach clean-up models, but additional approaches were developed to allow for effective targeting of known bottle stockpiles in gentrified coastal areas. Importantly, knowledge transfer to the villages included a means to differentiate PET from other plastics, usually by determining polymers known to be used in specific types of product packaging, or by learning to identify PET logos on the bottle labels.

Design and manufacture

Collected PET bottles occupy considerable volume and storing them can be a problem. This lack of space makes it difficult for a coastal community to store sufficient waste plastic prior to selling it on. To circumvent this problem, we collaborated with the Polyteknik ATI Makassar, which designed and manufactured pilot-scale PET conversion shredding and extrusion machines.

These machines constituted a core contribution to our circular economic pipeline, and to ensure our long-term plastic reuse goals could be met, Gunungkidul villagers were taught to use and maintain the equipment safely. The villagers are now able to shred and extrude collected PET plastic bottles to make wound filaments to sell to plastic banks, or for reuse in product development. The extruded wound filaments occupy considerably less volume per unit weight, for easier storage, and saving transportation costs.

Left: Teaching members of the local community about plastic recycling.

Below: Collecting PET from the coastline in a beach clear-up.

Sustainability and economic analyses

The final step of our project involved creating practical road maps to sustainability and economic growth. These are vital as they are a means by which we can easily inform villagers of their pathways to profit. To ensure we maintained the village's trust during the programme, two main actions were deemed indispensable.

First, we needed to setup and seed fund a micro-SME (Kelompok Tani dan Nelayan Drini) that would be owned and run by the village, and which would yield financial profit. Hence establishing a recycled PET production process. Secondly, a costing agreement was setup with a nearby plastic bank to take the extruded PET. Additional support was also provided to guide micro-SME registration, annual accounting, auditing and reporting.

Plastic economy

To further strengthen local circular economies in Indonesia, we must also support the creation and running of start-ups focused on recycled plastic product design, manufacture and distribution, both national and international. These aims should run parallel to upscaling of this pilot, such that there can be a plethora of local circular economies that utilise plastics from waste to product development and distribution.

Upscaling should not only be geographically inclined, i.e. targeting larger numbers of coastal villages, but should also be more holistic, using a greater variety of thermoplastic waste materials. In this small pilot project, we focused on PET, however, upscaling should be broadened to thermoplastics polystyrene (PS), polypropylene (PP), polyvinyl chloride (PVC), and high and low-density polyethylene (HDPE and LDPE), which are used ubiquitously in both shorter and longer lifespan disposable products.

Above: The plastic shredder developed under the pilot.

Product design constitutes a major gap in knowledge and practice in Indonesia, with plastic banks primarily selling plastics on to plastic product developers in Solo and Jakarta. Filling this gap in knowledge and practice in Indonesia within local coastal communities would allow for the creation of more lucrative plastic waste micro-economy business models.

Economic growth, health and the environment are considered three of the biggest challenges in Indonesia at present. Indonesia is classified as a low-to-medium income country with around 30 million people living below the poverty line, the current monthly threshold being IDR401,220 (US$27.72). Circular economies will help when centred on plastic waste management that fulfils several UN Sustainable Development Goals, the most important being goal one – no poverty, goal 12 – responsible consumption and production, and goal 14 – life below water. This pilot trial provides a much-needed template for the development of similar, scalable projects, and creates new mechanisms that couple economic growth with environment benefit.

Below: Locals were trained to use the equipment safely and independently.